SECTION 39

ASPHALT CONCRETE

Asphalt concrete shall conform to Section 39 of the Caltrans Standard Specifications and these City Standard Specifications.

39-1.01 Description. - Asphalt concrete is designated as Type A, Type B, Type C, or Open Graded. Type C asphalt concrete shall be as specified in the special provisions. Asphalt concrete is also designated by gradation, according to percentage of crushed particles and sand equivalent of the aggregate (for dense graded mixtures) or according to intended use (for open graded mixes) and by class, according to texture of the mixture. The use of recycled asphalt pavement (RAP) may be permitted at the discretion of the Engineer in type C mixes at a percentage determined by the Engineer not to exceed 15% of total aggregate weight.

Attention is directed to Sections 7-1.11, "Preservation of Property," 7-1.12, "Responsibility for Damage," and 8-1.10, "Utility and Non-Highway Facilities." The Contractor's operations shall be conducted in a manner that existing facilities or improvements will not be harmed or damaged.

At locations where public traffic is routed over the base grade, the Contractor shall plan the paving operations to minimize the delay of traffic.

The Contractor, when required to provide for the passage of public traffic through the work, shall do so in accordance with the provisions of Section 7-1.08, "Public Convenience," and 7-1.09, "Public Safety." The Contractor shall also conform his operations and comply with the provisions of Section 12, "Construction Area Traffic Control Devices."

39-2.02 Aggregate. - Aggregate for asphalt concrete mixtures shall consist of crushed or natural stone, gravel, sand, or other mineral material. The coarse and fine aggregate shall be composed of sound, tough, durable particles.

Approval of sources of supply of aggregate shall be obtained from the Engineer prior to delivery of the material to the plant.

Unless otherwise specified in the special provisions, the aggregate grading of the types of asphalt concrete shall conform to these Standard Specifications.

Type C will conform to 3/4 inch maximum, medium grading.

Unless otherwise shown on the plans or specified in the special provisions, Type B shall be used for the base lift course and for the surface lift course. Should the surface lift course be less than 2 inches in thickness, the type, gradation, and class shall be designated by the Engineer.

In Section 39-2.02 of the Caltrans Standard Specifications, the aggregate grading requirements tables, Types A and B asphalt concrete, for the following gradings, shall be deleted, and replaced with the following tables (all other gradation tables in Section 39 of Caltrans shall remain unchanged):

3/4" maximum, coarse
3/4" maximum, medium
1/2" maximum, coarse
1/2" maximum, medium
1/2" maximum, fine

In the following tables, the symbol "X" is the percentage based on the job mix formula established by the Engineer, based on aggregate materials and submittals from the Contractor and his supplier.

AGGREGATE GRADING REQUIREMENTS
Type A and B Asphalt Concrete
(Replacement Gradings)
Percentage Passing

Sieve Sizes	Operating Range	Individual Test
	3/4" Maximum, Coarse	
1"	100	100
3/4"	90-100	90-100
3/8"	60-75	55-80
No. 4	40-55	35-60
No. 8	27-40	X ± 5
No. 30	12-22	X ± 5
No. 200	3-6	X ± 3
	3/4" Maximum, Medium	
1"	100	100
3/4"	95-100	90-100
3/8"	65-80	60-85
No. 4	45-60	40-65
No. 8	30-45	X ± 5
No. 30	15-25	X ± 5
No. 200	3-7	X ± 3
	1/2" Maximum, Coarse	
3/4"	100	100
1/2"	95-100	90-100
3/8"	75-90	70-95
No. 4	50-67	X ± 5
No. 8	35-50	X ± 5
No. 30	15-30	X ± 5
No. 200	4-7	X ± 3
	1/2" Maximum, Medium	
3/4"	100	100
1/2"	95-100	90-100
3/8"	80-95	75-100
No. 4	55-72	X ± 5
No. 8	38-55	X ± 5
No. 30	18-33	X ± 5
No. 200	4-8	X ± 3

Sieve Sizes	Operating Range	Individual Test
	1/2" Maximum, Medium	
3/4"	100	100
1/2"	95-100	90-100
3/8"	80-95	75-100
No. 4	55-72	X ± 5
No. 8	38-55	X ± 5
No. 30	18-33	X ± 5
No. 200	4-8	X ± 3
	1/2" Maximum, Fine	
3/4"	100	100
1/2"	95-100	92-100
3/8"	80-95	77-100
No. 4	58-75	X ± 5
No. 8	43-60	X ± 5
No. 30	20-35	X ± 5
No. 200	6-12	X ± 3

When the combined grading of coarse and fine aggregates is deficient in material passing the No. 200 sieve, a commercial filler shall be added to the mixture as specified by the Engineer. The amount of commercial filler to be added shall be only that amount necessary to make the combined grading of the materials comply with the grading requirements for the completed mixture. In no case shall the amount of commercial filler added exceed 3 percent by weight of the combined aggregate.

The combined aggregate shall conform to the table in Section 39-2.02 of the Caltrans Standard Specifications except that the results of the Los Angeles Rattler test, loss at 500 revolutions, shall be a maximum of 33 percent for individual test or 30 percent for operating range, for Types A and B asphalt concrete.

Delete paragraph 8 (page 39-5, top) of Section 39-2.02 of the Caltrans Standard Specifications. In lieu thereof, if the results of either or both the aggregate grading and Sand Equivalent tests do not meet the requirements specified for individual test, the Engineer shall seek appropriate remedy as specified in Section 5, "Control of Work."

The asphalt concrete mixture shall conform to the quality requirements specified in Section 39-2.02 of the Caltrans Standard Specifications and to the following additional requirements:

Test	California Test	Asphalt Concrete Type* A	Asphalt Concrete Type* B	Open Graded Asphalt Concrete
Percent Voids	304	2-5	2-5	---
Film Stripping %	302	25	25	25
Swell	**	**	**	0.030"

* Including asphalt concrete base type.
** Covered in Caltrans Standard Specifications.

39-2.02A Job Mix Formula. - A job mix formula shall be established by the Engineer for each designation of asphalt concrete, based on samples of conforming aggregate materials supplied for each source or supplier proposed by the Contractor. Where more than one source or supplier is designated to supply asphalt concrete, those mixes will be kept separated. The mixes will not be intermixed in the same lift or section of pavement. The paving contractor will submit paving plans showing, in advance, where the mixes will be used from each source. This paving plan will be subject to approval by the Engineer. The job mix formula for each classification shall be within the limits as shown in the table below and as specified herein for aggregate grading requirements. The job mix formula will establish a single percentage of aggregate passing each required sieve size, a percentage of asphalt binder to be added to the aggregate, and a single temperature at which the mixture is discharged from the pugmill to the haul vehicle. Contractor may submit a job mix formula and mix design for consideration by the Engineer. Designs must be accompanied by current test results that indicate compliance with these Standard Specifications as well as Special Provisions.

The paving asphalt content of the mixtures will be calculated on percentage basis by weight of dry aggregate. The paving asphalt content for each designation of asphalt concrete shall not be less than the minimum limits given below.

Minimum Asphalt Content (%)

GRADATION AND CLASS		TYPE A	TYPE B	OPEN
3/4"	Coarse	4.5	4.5	
	Medium	4.5	4.5	
1/2"	Coarse	5.0	5.0	
	Medium	5.0	5.0	
	Fine	5.4	5.4	
3/8"	-			5.0
1/4"	-			5.5
No. 4	7.0	7.0		

After the job mix formula is established, all asphalt concrete mixtures shall conform to the production tolerances as indicated below. The tolerances as indicated are plus or minus the figures shown below:

SIEVE SIZE (Percent Pass)	TYPE A	TYPE B	Open
	Weight	Percent	Total Aggregate
No. 4	7	7	-
No. 8 & 30	5	5	-
No. 200	3	3	-
	Weight	Percent	Total Mixture
Asphalt Content	0.45	0.45	0.45
Temperature of Mixture	10° F	10° F	10° F

Any variation from the job mix formula greater than the percentage shown shall be investigated, and the conditions causing the variation shall be corrected immediately.

39-2.04 Equipment. - All equipment furnished for the hauling, spreading, and compacting of asphalt concrete mixtures shall be maintained in prime mechanical condition. Equipment that drips fuel, oil or grease shall be removed from the project site until leakage is corrected. Equipment shall be serviced and lubricated away from the paving site.

39-3.01 Storage. - The different aggregate sizes shall be kept separated until they have been delivered to the cold feed elevator feeding the dryer. The storage yard shall be maintained in a neat and orderly fashion and separate stockpiles shall be readily accessible for sampling. Each size of aggregate shall be separately fed by feeders to the cold elevators in proper proportion and at a rate to permit correct and uniform temperature control of the heating and drying operation. The aggregates shall be dried and delivered to the mixer at a temperature between 250°F and 325°F. The temperature between these limits shall be regulated according to the viscosity characteristics of the asphalt, temperature of the atmosphere, and the workability of the mixture. Aggregates in the hot bins shall not contain moisture to an extent to cause the mixture to foam, slump, or segregate during hauling and placing operations.

39-3.01A Cold Storage. - Once the job mix formula is established, based on samples of aggregate submitted by the Contractor, the aggregate at the cold feed to the dryer shall be within the tolerances as set forth below. The tolerance figures in the table are plus or minus the percent passing the sieve of the size indicated.

Sieve Size	Percent
No. 4 & Larger	10
No. 8	5
No. 200	3

39-3.01B Hot Storage. - The gradings of aggregate hot storage shall be as indicated in the following table.

Total Percent Passing by Weight

Sieve Sizes	Bin 4 3/4" x 1/2"	Bin 3 1/2" x 3/8"	Bin 2 3/8" x #8	Bin 1 fine
1"	100	--	--	--
3/4"	75 - 100	100	--	--
1/2"	0 - 25	80 - 100	100	--
3/8"	0 - 15	20 - 65	90 - 100	--
No. 4	--	0 - 15	30 - 60	100
No. 8	--	--	0 -15	85 - 100
No. 30	--	--	--	35 - 60
No. 200	0 - 2	0 - 2	0 - 6	6 - 14

39-3.03 Proportioning. - Delete paragraph one of Section 39-3.03 of the Caltrans Standard Specifications. The proportions of aggregate and paving asphalt, within the limits specified in the job mix formula, as specified in Section 39-2.02A, "Job Mix Formula," shall be regulated to produce a satisfactory mixture.

The sequence in which several aggregates shall be drawn or weighed may vary under different conditions. The paving asphalt shall be added in an evenly spread sheet over the length of the mixer box in a batch plant, or shall be spread evenly across the mixer box in a continuous mix plant.

39-3.04 Mixing. - The asphalt content of the asphalt mixture may be determined in accordance with ASTM Designation: D 2172 or as specified in Section 39-3.04, "Mixing" of the Caltrans Standard Specifications.

Mixing shall be accomplished in the shortest time that will produce a satisfactory mixture. Mixing time shall be within the following limits:

Batch Plants - 0 to 10 seconds dry mixing followed by 25 to 50 seconds mixing after the addition of the paving asphalt.
Continuous Mix Plants - 25 to 60 seconds based on the formula:

$$\text{Mixing time, s} = \frac{\text{pugmill capacity, lb}}{\text{pugmill output, lb/s}}$$

The Engineer or his authorized representatives shall have access at any time to all parts of the mixing plant to insure the manufacture of asphalt concrete mixtures in strict accordance with these specifications. In order that accurate and sufficiently large samples of aggregate may be obtained from hot storage, easy and safe access shall be provided to the location on the plant where samples may be taken.

39-4.01 Subgrade. - Subgrade preparation shall be in accordance with Section 21, "Subgrade Preparation," of these specifications. Delete Sections 39-4.01 and 39-4.02 of the Caltrans Standard Specifications.

39-5.01 Spreading Equipment. - Pavers shall be capable of spreading and finishing the asphalt concrete true to line, grade, and crown required.

The pavers shall be equipped with quick and efficient steering devices and shall have reverse as well as forward traveling speeds.

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with distributing screws of the reversing type to place the mixture uniformly in front of the screed.

The screed shall be equipped with a controlled heating device for use when required. The screed shall strike off the mix to the depth and cross section specified without the aid of manual adjustment during operation.

Particular attention shall be directed to the setting, clearance and wear condition of the tamper bar on paver screeds so equipped.

39-5.03 Hauling Equipment. - Vehicles used for hauling asphalt concrete mixtures shall have tight, smooth, metal beds, and shall be free from dust, screenings, excessive petroleum oils, volatiles, or other mineral spirits which may affect the mix being hauled. Trucks shall be provided with tarpaulins or cargo covers of sufficient size and weight to protect the entire load. Loads shall be covered whenever precipitation is in the air, when the air temperature is 50°F or

below, if the temperature of any load leaving the plants falls more than 20°F between the time of leaving the plant and placing on the roadbed, and at other times as the Engineer may direct. The Contractor shall provide haul trucks of size, speed, and condition to ensure orderly and continuous operation.

39-6.01 General Requirements. - No asphalt concrete paving mixture shall be placed when the weather is foggy or rainy, or the ambient air temperature is 50°F or below.

Asphalt concrete paving mixtures shall be placed only when the surface is dry and in satisfactory condition. In case of sudden rain, the Engineer may permit the placement of mixtures in transit from the plant, provided that the subgrade is free from pools of water and the mixture is laid and compacted at the proper temperature.

39-6.02 Spreading. - The speed of the paver shall be regulated to eliminate the pulling and tearing of the mat. The paver shall be related to the production rate of the plant and hauling equipment and to the capability of the compaction equipment. Pavers shall be operated in a manner that will insure continuous and uniform movement. There shall be a minimum of intermittent paver stops and starts.

The table below sets forth approximate paver speeds, for various delivery rates and thicknesses of pavement, necessary to achieve continuous paving operation 12 feet wide.

Thickness	Delivery Rates			
(feet)	100 ton/hr.	150 ton/hr.	200 ton/hr.	250 ton/hr.
0.08	24 ft./min.	36 ft./min.	48 ft./min.	60 ft./min.
0.13	18 ft./min	27 ft./min.	36 ft./min.	45 ft./min.
0.17	12 ft./min.	18 ft./min.	24 ft./min.	30 ft./min.
0.25	8 ft./min.	12 ft./min.	16 ft./min.	20 ft./min.

In limited areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the asphalt concrete mixture may be spread, raked, and luted by hand tools. The mixture shall be thoroughly compacted by means of pneumatic tampers or other methods as will produce the required degree of compacted thickness.

When hand spreading is permitted, the mixture shall be dumped either on the grade or on dump sheets outside the area upon which it is to be spread, and then distributed into place using hot shovels, and spread with hot rakes in a uniformly loose layer to the full width required, and at a depth that, when the work is completed, it will have the required thickness and will conform to the grade and surface tolerance specified. Fanning or broadcasting of material across the mat will not be permitted.

Whenever hand spreading or backwork is required behind the paving spread, the paving machine shall be stopped until such hand spreading or backwork is completed.

Longitudinal joints and edges shall be constructed to true line markings. Lines for the paver to follow in placing individual lanes shall be parallel to the centerline of the roadway or to a baseline established by the Engineer.

The material being placed in the abutting lanes shall be tightly crowded against the face of the previously placed lane. The paving machine shall be

positioned to overlap the existing mat only to the extent that the material placed against the joint is tightly crowded against the vertical face at the joint and that the conform raking leaves no ridges or depressions. Before compacting or pinching the joint, the coarse aggregate in the overlapped material that has dislodged through raking shall be removed from the pavement surface and discarded.

Transverse construction joints and temporary runoff tapers shall be constructed so that no gradual ramping down of the mat occurs back from the joint.

39-6.03 Compacting. - The completed pavement shall have an average density equal to or greater than 98 percent of the laboratory density derived from compacting and testing the mixture in accordance with California Test 304 and 308. The laboratory-compacted specimens will be composed of the same materials, in like proportions, as the job mix formula.

Final compaction of the paving may be tested by nuclear density gauges California Test 375 or by coring and testing cores in accordance with California Test 308, to establish compliance with these specifications. In the event of non-compliance with these specifications, the Engineer may require that the nonconforming segments of paving be replaced, or may assess the Contractor a penalty amount to be deducted from the contract amount for this payment item, for each cubic yard of asphalt concrete not in compliance. For each ton of asphalt concrete not in compliance with these specifications, the Engineer may require that the nonconforming segments of paving be replaced or assess the Contractor a penalty to be deducted from the contract item amount.